Forest Pest Management

Pacific Southwest Region

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To: District Ranger, Downieville RD, Tahoe NF
Subject: Pendola fire (NE00 - 2)

At the request of Jeanie Masquelier, District Ranger, I conducted a field evaluation of the Pendola fire on December 8, 1999. The objective of my visit was to examine various areas within the fire, discuss marking guidelines and address several resource questions posed by District personnel. Most questions involved some projections regarding the role bark beetles are likely to play in the fire damaged areas. Several District personnel and an individual from the U. S. Fish and Wildlife Service accompanied me in the field. The day was recorded on video for a future public meeting.

Background Information

The fire started in the area on October 16, 1999 and burned about 12,000 acres of which approximately 2,500 are on the Tahoe National Forest. The burned area on National Forest land is located north of and adjacent to Bullards Bar Reservoir at about 2,000 to 2,500 feet in elevation. Soils in the area are highly erosive and some areas have a hard pan just below the surface. Bald eagle habitat and a Protected Activity Center (PAC) for California spotted owls are contained within the burned area.

Conifer species are predominantly Douglas fir and ponderosa pine with some sugar pine, incense cedar and white fir. Hardwood species are tan oak, madrone, black oak and some live oak. Prior to the fire there was a dense shrub cover, especially in the plantations, composed of white leaf manzanita, blackberry and *Ceanothus* sp. The area contains good growing sites (Dunning 1A).

It is the intent of the Ranger District to leave all trees that are likely to survive their fire-related injuries. Fire injured trees which are still alive will be evaluated for retention or removal based on criteria presented in The Guidelines for Estimating the Survival of Fire-Damaged Trees in California by W. Wagener (Misc. Paper No. 60, Pacific Southwest Forest and Range Experiment Station, 1961) and comments by C.P. Weatherspoon, where he summarizes and discusses the above mentioned guidelines and provides additional suggestions to facilitate the decision making

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process related to fire damaged trees (Weatherspoon, C.P. 1987. In: Proceedings of the 9th Annual Vegetation Management Conference, Nov. 3-5, 1987, Redding, California. Pg. 106-110.)

Field Observations

My observations during the field visit indicated very little bark beetle activity that would be associated with an increase in tree mortality. This would be expected due to the fire occuring after what would be considered the main beetle flight season for that area. In addition, it is anticipated that bark beetle populations in the area (as evidenced by very little tree mortality over the past few years) are relatively low due to the previous three seasons of above normal precipitation which positively influences the health and vigor of the trees. The beetle activity noted during the field visit was as follows: 1) several of the fire damaged ponderosa pines have red turpentine beetle pitch tubes near the ground line; 2) unsuccessful western pine beetle attacks are present on some pines and 3) there is evidence of secondary beetle activity on many of the fire killed trees.

Red turpentine beetle, *Dendroctonus valens*

The red turpentine beetle normally attacks injured, weakened or dying trees and freshly cut stumps. The adults are attracted by fresh pine resin. In the Pendola fire the red turpentine beetles are attracted to the trees with fire-related injuries. A beetle-produced aggregation pheromone is also important in attracting additional beetles into suitable hosts.

Attacks usually occur at the soil line or root crown and are characterized by a large reddish pitch tube at the point of entry. If an attack is successful, the adults excavate an irregular gallery in the cambium and the female lays eggs along the sides. Attacks usually do not kill trees but may predispose them to attack by other bark beetles. Repeated or extensive attacks by the red turpentine beetle can kill pines. Little can be done to control red turpentine beetles once they are beneath the bark. Good health and vigor in a tree and minimizing fire-related injuries are the best protection against infestation. The feeding activity of the adult beetles and their larval offspring kills a limited amount of living tissue. If enough beetles attack a tree so that feeding areas overlap the tree will die as a consequence of the girdling.

Over the past three years elevated levels of red turpentine beetle activity have been noted in several areas in northeastern California. All cases have been associated with wildfires, prescribed fires or thinning activities. To date, these attacks have not caused elevated levels of mortality. In the prescribed fires and wildfires, post-fire mortality has been observed but was caused by fire-related injuries (primarily cambium kill) as opposed to bark beetle attacks. FPM has been monitoring 50 Jeffrey and ponderosa pine trees on the Lassen NF that were attacked by RTB following a thinning in 1995. The number of attacks on these trees ranged from 2 to 100+ and were found up to 15 ft. up the bole. To date, two trees have died. Based on this information, observations following other fires, and the moist precipitation pattern over the past three years, I would not anticipate any mortality related to the red turpentine beetle attacks. Additional mortality related to fire injuries can be expected in areas where the fire was hot enough to burn significant portions of the cambium or in areas where the residual tree crown is not sufficient to sustain the tree.

Western pine beetle, *Dendroctonus brevicomis*

Some of the ponderosa pines I examined had western pine beetle pitch tubes on the mid and upper boles. All attacks were on trees that were killed during the fire. Western pine beetle attacks which occur on trees without moist cambium will not be successful in producing brood. There should be no concern regarding bark beetles building up in trees that have been killed outright by the fire. At the time of the field evaluation I did not note any western pine beetle attacks on live trees and/or trees that would be expected to survive their fire-related injuries. For the reasons mentioned above (adequate precipitation for the past three years and the timing of the fire related to the bark beetle flight) low level of bark beetle activity are not a surprise; however, it is important to continue observations in the area and be aware that an increase in bark beetle activity may occur this spring and summer, particularly if we have a dry winter.

The western pine beetle breeds in the main bole of living ponderosa pine larger than about 8 inches dbh. Normally it breeds in trees weakened by drought, overstocking, root disease, dwarf mistletoe or fire. Adult beetles emerge and attack trees continuously from spring through fall. Depending on the latitude and elevation, there can be from one to four generations per year. Initial attacks are made about mid-bole and subsequent attacks fill in above and below. Pitch tubes are formed on the tree trunk around the entry holes. The pitch tubes are red-brown masses of resin and boring dust. Relatively few, widely scattered, white pitch tubes usually indicate that the attacks were not successful and that the tree will survive. Pheromones released during a successful attack attract other western pine beetles. Attacking beetles may spill over into nearby apparently healthy trees creating "group kills".

The availability of suitable host material is a key condition influencing western pine beetle outbreaks. In northeastern California, drought stress may be the key condition influencing outbreaks. When healthy trees undergo a sudden and severe moisture stress, populations of western pine beetle are likely to increase. Healthy trees ordinarily produce abundant amounts of resin, which pitch out or eject attacking beetles. When deprived of moisture, stressed trees cannot produce sufficient resin flow to resist attack. Any condition that results in excessive demand for moisture, such as tree crowding, competing vegetation, protracted drought periods, or any condition that reduces that ability of the roots to supply water to the tree, such as mechanical damage, root disease, or soil compaction, can cause moisture stress and increase susceptibility to attack by the western pine beetle.

Secondary insects

The presence of wood borer frass on the boles, and galleries under the bark, was noted on several of the fire killed trees. There are a number of species of flatheaded (family Buprestidae) and roundheaded borers (family Cerambycidae) that mine in the sapwood, and in some cases, in the heartwood, of dead and dying trees. Attacks initially occur within the first few years after a fire, but can continue for 4 or 5 years, as long as the wood remains sound. The damage to the sapwood and heartwood from these insects, along with fungal deterioration, can be a factor in determining the limit of practical salvage in an area. At this time, wood borers would not be expected to cause any concerns with the trees that survived the fire unless their extent exceeds about 1/3 of the circumference of the bole on individual trees. (see Question 1 below). Their presence may become more important if we experience a dry winter and the fire-injured trees remain stressed.

Insects that bore into the sapwood and cause degradation also include the ambrosia or pinhole borers. The defect caused by this beetle consists of small holes surrounded by a dark stain.

Galleries are constructed within the sapwood where the larvae feed on the ambrosia fungus which is introduced by the female beetle as she constructs the galleries. Ambrosia beetles were present in the fire-killed trees as evidenced by piles of fine, white boring dust in the bark crevices.

Wood borers and ambrosia beetles are common in dead trees following wildfires and are important components in decomposition of the wood. Depending upon management objectives, prompt removal of the dead trees will keep the damage to the wood at a minimum.

Discussion

Fire damaged trees can be placed into three categories: 1) those killed outright or so severely damaged by the fire that they are dead or will soon die; 2) those that are undamaged or lightly damaged and should survive, and 3) those in between. Based on my observations in the areas we visited, most of the trees are in either category 1 or 2. Trees in the third category present the challenge in marking and also provide the opportunity for subsequent attack by bark beetles.

Based on information from other wildfires in California, trees not injured by the fire either within the area of the burn or in the surrounding forest are rarely attacked as a result of the concentration of bark beetle attacks in fire-injured trees. As mentioned previously, a period of moisture stress could be an exception. Concentration of beetles and related losses typically occur within the first two years after the fire so trees around the fire boundaries and islands of green trees within should be monitored for bark beetle activity through 2001.

Decisions about post-fire harvest and stocking levels affect the biological and economic potential of a stand. Unfortunately, it is often difficult to separate injured trees which are likely to live from those which are likely to die. The guidelines noted above (Wagener, 1961 and Weatherspoon, 1997) are the most appropriate to use for California forest conditions. Trees with moderate damage should be marked for removal when they do not meet the minimum criteria for survival. Damage to the crown and intensity of the fire, which indicates cambium injury, provide an index to mortality. An adequate number of trees within descrete areas of the burn should be sampled to determine the level of cambium damage for a given area. Sampling the cambium for damage is the proper procedure to assess the extent of cambium kill. Bark scorch alone is not an accurate indicator of damage to the cambium.

If pines with some green foliage are cut, any slash >3 inches in diameter could be used as breeding material for pine engravers, *Ips* sp. During the warm parts of the year pine engravers can complete their life cycle in less than 2 months. If populations are allowed to build up and emerge from the slash they can attack standing residual trees and cause either whole tree mortality or top kill. Pine slash can be treated by lopping and bucking the boles and larger stems into the shortest pieces possible (varies depending on diameter but typically about 3 ft.). The material should be scattered so the stems are fully exposed to the sun to facilitate drying. Other methods of slash treatment include chipping, removing from the site or piling and burning. Two practices which should generally be avoided are piling fresh slash without further treatment and/or allowing slash to remain in contact with or near leave trees.

Specific Questions asked by District Personnel

1. What is the best way to identify insect attacked trees that are likely to die?

   Successful attacks on pines are easily identified by reddish-colored pitch tubes on the bole. Pitch tubes that are cream in color are unsuccessful. All red turpentine beetle pitch tubes

should be excluded when determining survivability. It would be prudent to mark pine trees that have successful attacks regardless of the extent of fire injuries. Frass in the bark crevices should be used as an indicator for other conifer species. Frass around the bole totalling at least 1/3 of the circumference can be used as a valid criteria in addition to or in the absence of fire damage.

2. What is the likliehood of survival for green, partially burned trees within intensely burned areas?

Sample some of the trees for cambium damage and assess tree crowns. Apply Wagener's guidelines with Weatherspoon's modifications and mark trees accordingly. As mentioned above, it is rare that bark beetles will attack in these islands of green trees; however, the trees should be monitored for activity.

3. If snags are retained within or near green clumps, does this put green trees at greater risk for insect attack.

There is no risk involving insects associated with leaving snags under the assumption that a snag is defined as a completely dead tree and therefore would not be viable habitat for bark beetles.

4. If higher snag retention standards were set within broader areas to maintain trees for eagles, does this increase the risk of insect attack throughout the surrounding area?

Similar to Question #3, there would be no increase in bark beetles associated with leaving more snags for eagle habitat.

5. Within SMZ's, how does snag retention affect the risk to remaining trees?

There is no risk regarding bark beetles and snags in SMZ's.

6. Does the species composition of the green trees influence the likelihood of their surviving insect attack? Size of tree? Location?

Yes, most of the bark beetles in California are host specific so species composition plays an important role in stand and bark beetle dynamics. The trees of most concern for bark beetle-related mortality would by the pine species and white fir. Tree size appears to be important for the pine bark beetles. Typically pine trees greater than 8 in. dbh are attacked but attacks have been observed in much smaller trees during protracted drought periods. Fir engraver usually attacks white fir trees greater than 4 in. dbh. Stand conditions in terms of species composition, density, age, size and precipitation appear to be the most important factors involving bark beetle and host interactions.

Incense cedar, Douglas fir and the hardwood component in this area are not typically associated with insects that would cause tree mortality.

7. If a 20 or 50 acre bald eagle nest core were identified, with all snags retained within this area, would this put surviving trees at a greater risk of insect attack? How would retaining snags along the water's edge affect insect infestation in the surrounding area?

See Answers #3 and #4 above.

8. Would removing a portion of the standing dead reduce the risk of insect attack?

No, there is no risk of attack associated with dead trees.

9. Approximately 200 acres of a 300 acre PAC burned intensely. What is the risk of insect attack to the intact area?

Based on my observations during the field visit there is little risk of post-fire bark beetle attacks in the areas that did not burn; however they should be monitored for activity for the next two seasons.

10. Would intensively logging a strip or block along a road and/or implementing a non-commercial removal of smaller diameter snags adjacent to the PAC better protect the stand? Would underburning the stand?

The best way to reduce future bark beetle-related mortality is to maintain the stand at stocking levels that are appropriate for the site, including diverse species composition, ages and size classes. It is recommended that activities such as thinning or underburning be implemented during periods of relatively low tree stress (i.e. during high precipitation years and prior to stands becoming overstocked). This provides the opportunity for trees to recover quicker from the management activity and doesn't induce additive stresses on the trees. Additive stresses increase the susceptibility of successful bark beetle attack.

11. If there are small patches of dead trees within the PAC, does leaving these put it at greater risk to insect attack.

No, there is no risk associated with dead trees and subsequent bark beetle attack.

I will continuing working with Terri Walsh on the marking guidelines and will assist you with any further needs you may have. Please feel free to call me at 530-252-6667 if you have more questions or need to request additional assistance in the field.

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